NEW TECHNOLOGIES AND SCIENTIFIC PARADIGM

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Summary

There are many factors in modern world of technology and economy. All these processes function according to very specific laws. This paper defines the term science, laws on scientific cognition are considered in detail and the term and importance of scientific paradigm is pointed out. The relation between science and technology is considered in detail, the importance of technical sciences is emphasized. The conclusion deals with the relation between university studies and technical sciences and the need to connect education with the application of research results in technical sciences.

NOVE TEHNOLOGIJE I ZNANSTVENA PARADIGMA

Sažetak

U suvremenom svijetu tehnologije i ekonomije djeluju mnogi činitelji. Svi ti procesi ravnaju se prema sasvim određenim zakonima. U radu se ukazuje na definicije pojma znanost, razmatraju zakoni iz znanstvene spoznaje te ukazuje na pojam i važnost znanstvene paradigme. Razmatra se odnos znanosti i tehnike te ukazuje na značaj tehničkih znanosti. U zaključku se ukazuje se na odnos sveučilišnih studija i tehničkih znanosti te na sve veći akcent na spoju obrazovanja i primjene rezultata istraživanja u tehničkim znanostima.

NEW TECHNOLOGIES AND SCIENTIFIC PARADIGM

There are many factors in modern world of technology and economy. All these processes function according to very specific laws which human civilization cognized from science.

1. WHAT IS SCIENCE

There are many definitions of science - and their grouping depends on the approach to the science itself. *Science is* - according to many authors - *entirety of systematized human knowledge*, in other words rational classification of objective reality, which goes further than data.[1]

Science is defined also as rationally based knowledge about a subject which uses defined frames of terms and elaborated research methods. Encyclopedic description of the term science is somewhat more specific; science is generalized experience and in practice tested human knowledge, which is systemized on the basis of specific laws and phenomena of the world and relations between them. Science is, also, in the same time methodologically based research in which every statement must be based on sufficient and significant rational reasons, and their validity for the subject must be confirmed by the applicability in practice or by experimental methods or, by successful predicament of future events (20,70).

Science can be also defined as systematized knowledge, entirety of perceptions organized in fields of research and deduced according to rationally based methods on the basis of observing of phenomena and processes of nature and society in order to explain them and be able to master them. Etymologically, the term science (in Croatian from the word "*znati*" - to know) stands for the sum of human knowledge and cognition - but more precisely it does not include every kind of knowledge (ex. knowledge obtained only by perception through senses), but it includes implicitly general knowledge, deduced by strict, methodologically specified criteria of cognition. [2]

Science, in its essence, rises from eternal human striving to learn about, to comprehend and understand the world around us - in order to be able to change it meaningfully. This is why the science is - as a practical-cognitive activity - permanently connected with materialistic needs of

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[1] *For example: definition of science like "sum of systematized and true data and knowledge" is not correct, because even telephone book is sum of systematized and true data, but cannot be called science.*

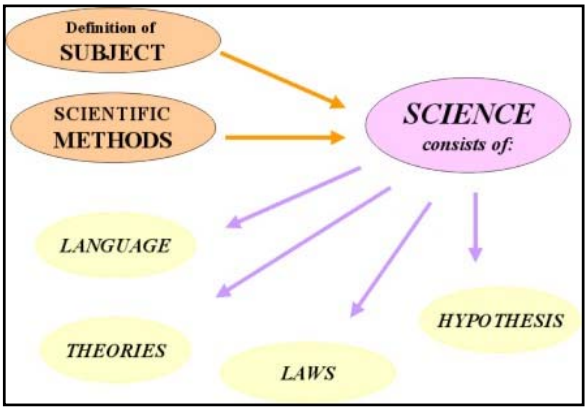
[2] *In this context - Croatian term "znanost" has the same meaning as the Latin word "sciencia", or in English "Science" or in German "Wissenschaft". Terms science and are often used as synonyms, although there are other explanations; as a term meaning entirety of knowledge (in Latin "doctrina", in German "Lehre", in English "studies") or with a meaning of a comptete theory.*

society and has a function of - gaining knowledge for the achieving of human goals. As an entirety of systematized knowledge and as a system of gaining new information - science is not only provider of bare information and useful instructions for concrete actions. By forming that part of spiritual production that has to be objective, verifiable in practice and unambiguously precise - science plays irreplaceable role in forming general and specific conceptions of the world. This is why scientific research work involves - beside direct discovery of facts - also the reflective (contemplative) synthesis of individual truths, in other words their theoretical generalization.

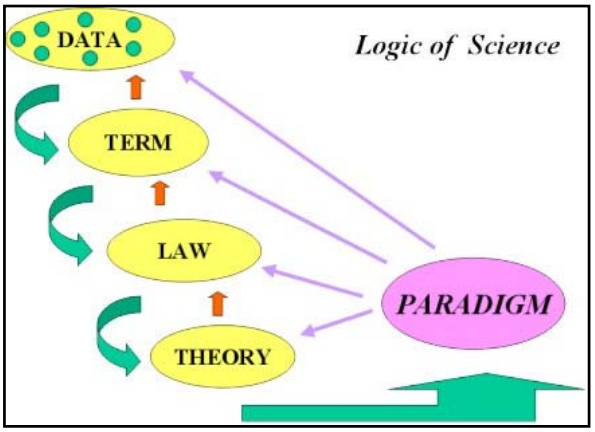
Consequently, science represents the system of establishing objective truths about reality. We have to distinguish between (a) ***static*** and (b) ***dynamic*** standpoint of understanding science. According to static standpoint science is organized system of exact data about the world, and according to dynamic standpoint science is also the process of gaining the data. Here we also have to point out the secondary - but also important and permanent function of scientific work: science produces not only new information (knowledge) but also new understandings (attitudes) which explain scientific achievements, nature and world.

For the well-known mathematician, physicist and science philosopher *Jacob Bronowski* - science is experiment, trying; "*It is (…) trying every possible alternative, intelligently and systematically, then rejecting every failure and accepting every success no matter if it is against our prejudices. And success adds another little piece to slow and hard, but victorious understanding of our world."* (1,10) Bronowski especially emphasizes that values of science are honesty, tolerance, independence, rationality and consistency of mind (moral and intellectual stability) and its achievements counts in among human's greatest triumphs. According to this mathematician, science was not spreading secretly but holding to the clear facts and only facts - no matter who discovered them or who denied them.

Science consists of (a) ***definition of a subject*** and (b) ***scientific methods***. On the basis of the definition of the subject and re-searches - using adequate methods - we get concrete data about the subject and on the basis of the data we can develop: language, hypothesis, laws and theories (fig.).



Every science integrates elements of its structure into its logical system. Logic of the science (when explaining the subject of its interest) explains the data by a term, terms by a law, laws by theory and theory by paradigm (fig. 2)



Goals of science

Despite popular impressions of science, it is not the goal of science to answer all questions, only those that pertain to physical reality (measurable empirical experience). Also, science cannot possibly address all possible questions, so the choice of which questions to answer becomes important. Science does not and can not produce absolute and unquestionable truth. Rather, science consistently tests the currently best hypothesis about some aspect of the physical world, and when necessary revises or replaces it in light of new observations or data.

Science does not make any statements about how nature actually "is"; science can only make conclusions about our observations of nature. The developments of quantum mechanics in the early 20th century showed that observations are not independent of interactions, and the implications of wave-particle duality have challenged the traditional notion of "objectivity" in science.

Science is not a source of subjective value judgements, though it can certainly speak to matters of ethics and public policy by pointing to the likely consequences of actions. However, science can't tell us which of those consequences to desire or which is 'best'. What one projects from the currently most reasonable scientific hypothesis onto other realms of interest is not a scientific issue, and the scientific method offers no assistance for those who wish to do so. Scientific justification (or refutation) for many things is, nevertheless, often claimed.[3]

2. ON LAWS DEALING WITH SCIENTIFIC COGNITION

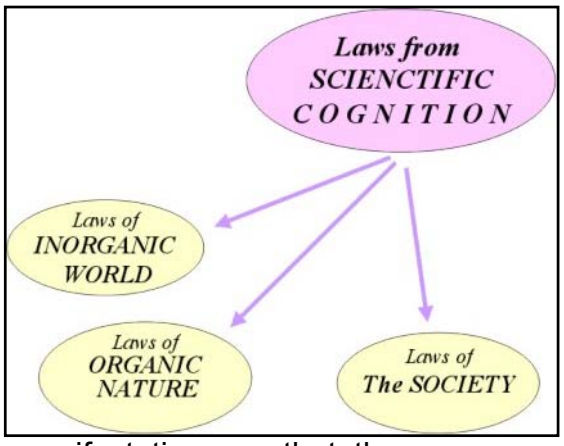
The term science in cognitive sense represents one of the levels of human cognition of the world. This means that we, through scientifically defined laws, characterize the level of understanding of unity and interdependence of all processes of the world - universe, nature and society. What did individual scientists and philosophers say about laws

[3] From www. ipedia.com

dealing with scientific cognition? A number of authors agree that scientifically defined law is the greatest achievement, that is, the goal of scientific research. Suchlike scientifically defined laws are something that is permanent, identical with phenomena of the same class of terms; in other words every suchlike law is nonviolent reflection of phenomena. *Ivan Maksimović*; starts from the thought that the term "*law*" is similar to the term essence - under which he understands "*the entirety of all inner relations and processes that determine main characteristics and tendencies in development of phenomena*". *Bogdan Šešić* emphasizes that "*the man, by the laws of scientific cognition, reflects only general and important characteristics of objective description of specific type of things or phenomena".* *(Details 9, 32-38)*

We can say that the man has, during his history, created civilization and enlarged humane dimension of the world by increasing of the number of term and discovering the essence for a great number of things and phenomena, shifting the borders of important for those things and phenomena. This is why *Mihajlo Marković* warns how relevant for the practice the term law is: *" introducing of the law category with its usual content (relatively constant, general and necessary relationship in reality) introduces a certain order and regularity in our practice and orientates us towards planning and predicting future experiences."*

The majority of authors agree that there are three groups of laws in the world. These are a) laws of ***inorganic world,*** b) laws of ***organic nature*** and c) laws of the ***society***. These laws ***differ according*** to 1) the ***area*** in which they are valid, and 2) the ***way*** of there.



Laws of inorganic nature (ex. Laws of physics) act always in the same way, automatically; ex. Gravity law. Laws of organic nature (ex. biology) are not in that measure automatic, but there is a very explicit regularity; ex. regularity of heredity in the world of animals. When we speak about laws of society we can not say that they have automatically manifestations or that they are very distinctly regular. Individual way of manifestation of these laws is regularly different from the general rule and it manifests in a specific way - only as a tendency in a mass of individual cases.

Consequently, it is the same with finding evidence on existing/not existing and validation of specific laws. Discovering and finding evidence

for the laws dealing with in-organic world can be done very precisely and can be proved by experiments. It is the same with laws dealing with organic world, but the possibilities of proving of laws of society are very limited. *Branko Horvat* is right when he emphasizes that "*in social sciences the possibility of precise proving is smaller and this is the reason why schools of different scientific conviction can coexist for such a long period*."(9,32-38)

What kind of relationship do human beings have towards laws of the world? On the cognitive level we should quote *Emmanuel K*ant who thinks that mind has to approach nature with its principles in one hand and with experiment developed according to those principles in the other hand. The principles have to be in accordance with phenomena of nature that could be valid as laws. Mind approaches Nature with the aim of learning from nature, but acting like a judge who forces witnesses to answer his questions. When we talk about praxis we have to quote *Friedrich Engels* who emphasizes that - freedom, consequently, consists of the power over ourselves and over external nature. The power is based on our knowledge of necessities of nature. According to *F. Engels* - freedom of will means nothing but ability of deciding on the basis of knowledge. Consequently, the more free human reason is, in relation to a specific question, content of this reason is determined by more necessity. In the same time, insecurity has in it essence ignorance and chooses, seemingly free, one among many different contradictory solutions. This fact proves that it is not free and that it is submitted to the subject she should master. (9,32-38)

2. THE SCIENTIFIC PARADIGM

Scientific conclusions have different degree of including; some of them are valid only for specific (narrow) field of scientific observation, others include whole scientific disciplines, and there are those significance spreads even wider. The highest level of scientific generalization that develops and is valid for the whole field of natural sciences, and by this for the science in general, is represented by the most general view of the world and cognitive methods, by the conception that takes the central position in scientific approach to the reality during particular epoch. This supreme conceptual attitude on scientific view of the world is called differently - but during last decades prevailed the term ***paradigm*** - introduced by the well-known philosopher of sciences *Thomas Kuhn*.[4]

[4] British mathematician and philosopher of science – J.Bronowski used the term "*Central concept of science*". W. Heisenberg - "*Physical view of the world*" or another author: "*Types of rational thinking*" or "*Styles of scientific thinking*", "*Groupthink*", "*Mindse*t", "*Episteme and discourse*" etc. (10,89)

The term ***paradigm*** originated from the Greek word **παράδειγμα** (*paradigm*) which means "pattern" "*form*", "*mode*l", "example", "*sample*", "*example for reputation*". T. Kuhn has, in his famous *book The Structure of Scientific Revolutions* (1962.) defined paradigm *as "universally recognized scientific achievements which provide us, for some time, with models of problems and solutions*".

Thomas Kuhn introduced and term "***paradigm shif***t"; this term given for the process and result of a change in paradigm -- usually total revolution in theory or worldview. It was originally a term referring to science but has become more widely applied to other realms of human experience as well.

Throughout the history of development of science fundamental natural sciences (most of all physics) have exceptionally crucial function in determining most general scientific models of objective reality. Scientific think of all epoch is originated from leading paradigm.

MEDIEVAL PERCEPTION OF THE WORLD

Before 1500 overall comprehension of the world (in Europe and majority of other civilizations) was of organic nature. Scientific frame of the organic comprehension of the world based on two authorities: Aristotle and Church; but the nature of medieval science is explicitly different from the nature of modern science.

MECHANISTIC PARADIGM - is the understanding of the world according to which everything - matter, nature, man and society - functions like a machine. Mechanistic paradigm has its origin in the works of *Rene Descartes, Frances Bacon* and *Isaac Newton*, and is based on the concept of absolute space and time, on elementary particles and causal nature of physical phenomena. This pattern of scientific thinking became mostly used and was leading almost 300 years in all sciences due to the fact that by this paradigm: **a**) could answer all questions **b**) was simple and **c**) it seemed logical. Everything that happened in the world could be mathematically explained and scientifically proved. On the basis of such cause-consequence state everything was predictable, that is to say determined. Natural phenomena take place - according to this paradigm - in three-dimensional, Euclidean space -independent from the phenomena that take place in it. The fact that space is absolute is connected with the fact that time is absolute and flows independently from past to future. Matter consists of atoms, particles that are composed of always the same parts (so that the total amount of substance can be expressed by its mass), and the movement of the particles is the result of the gravity. The gravity is different from the nature of matter and does not depend on inner structure of matter. The universe in unchangeable because the nature is ruled by strict laws of causality (Details: 2, 55-66).

NEW PARADIGM - New facts and new practice demand new conceptual view of the world; the new view of the world and new paradigm result from new facts of quantum physics and theory of relativity. Quantum theory (works of *Niles Bohr*, *Werner Heisenberg* and others) has shown that subatomic particles are not separated particles, but forms of probability, mutual relations in cosmic net, which includes human observer and his conscience. Theory of relativity (works of *Albert Einstein*) discovered the cosmic net and its innate dynamic nature, showing that its activity is the essence of its existence. It was shown that nobody knows exactly the position of subatomic particles in space (N. Bohr introduced the term of complementation - particles and waves are two complementary descriptions of the same reality) and that the relations are not deterministic, but stochastic. On the basis of this fact, instead of mechanistic approach, we have new - holistic approach, where instead of causality and simplicity in its essence, there exists only self-organization and complexity. Chaos is special expression of forms of complexity, and SYNERGY becomes the characteristic of spontaneous work of the parts of some system, which are achieving the goals of the whole. Information gets special place in the conception of the world. Complexity, chaos and SYNERGY are common characteristics self-organizing systems. Those are the systems which have the ability to enter new - complex state. This passing into the new state cannot always be predicted because the system can choose between several possibilities, in other words - through self-organizing system the change of the structure takes place spontaneously.

In his book "*The Turning Point*" *Fritjof Cap*ra announces paradigm that is in the process of coming into existence. He writes:" New view of the reality, we talk about, is based on the consciousness about important mutual links and interdependence of all phenomena - physical, biological, psychological, social and cultural. It crosses contemporary borders of terms and disciplines and it will be supported by new institutions. For now there is no accurately defined frame (by terms nor institutions) which would be suitable for the new paradigm, but many individuals, associations and structures are developing new ways of thinking and they are organizing themselves according to new principles.[5]

Capra suggests that the bootstrap approach, similar to approach developed by modern physics, could be the most useful one. That would mean gradual forming of the network of interdependent terms and models and, in the same time, creating of adequate social organizations. "*Not one of the theories and not one of the models would be more fundamental than others, and all of them would have to be inter-consistent. They would*

[5] Bootstrap scheme - theory of elementary particles, according to which the existence of single particle contributes to the forces that exist between that particle and other particles; those forces build connected systems, which are, in fact, the particles. (2,100)

surpass conventional disciplinary differences and use language suitable for describing different forms of multi-layered and interconnected parts of organized structure of society."

Capra especially describes the S-matrix theory that, according to him, has deeper implications for issues of paradigm and transformation of the perception of the world. *"Philosophic basis of S-matrix is known as the Bootstrap approach" - that was introduced by Geoffrey Chew. According to the Bootstrap philosophy, the nature cannot be reduced to elementary entities, representing basic constructive parts of matter, but has to be understood exclusively on the basis of self-consistency*. /Bootstrap approach in physics is very similar to general system theory. It emphasizes relations rather than separate entities and, as in the system theory, it perceives those relations as essentially dynamic. Systematic thinking is structured as a process: form is connected with a process, interrelation with interaction, and contrasts are united through oscillation.[6]

New view of reality, about we talk, founded on the consciousness of the essential mutually connection and mutual dependence of all phenomena – physical, biological, psychological and phenomena of society. This concept of thinking and view of world approach limit of all actual discipline's and notion's and will developed in new scientific concept (Capra, 3, 32).

Francis Heylighen wrote about a new transdisciplinary paradigm for the study of complex systems; "*Some implications of such an encompassing paradigm on the level of science, technology, individual persons and society are. It is argued that the further development of such a transdisciplinary approach will lead to a new "science of complexity"*. [7]

3. SCIENCE AND TECHNOLOGY

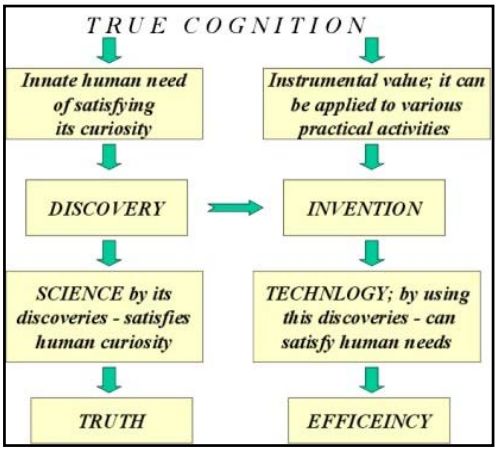
In his book "*Dialectic Theory of Meaning*" (Dijalektička teorija značenja) Mihajlo Markovic emphasizes that the true cognition has twofold value: a) it meets the human need of satisfying its curiosity and b) every cognition has its instrumental value, because we can apply it in various practical activities.

The science, by its disco-veries, satisfies human curiosity, and technology - by using these discoveries - can satisfy a great number of human needs. This is why the science is based on discovery and technology on inven-tions. Science discovers what exists in objective

[6] Bootstrap scheme - elementary particles theory according to which existence of separate particles contributes to forces acting between the particle and other particles.

[7] Heylighen F. "*A New Transdisciplinary Paradigm for the Study of Complex Systems*", in: Self-Steering and Cognition in Complex Systems, Heylighen F., Rosseel E. & Demeyere F. (ed.), Gordon and Breach, New York, 1990.

reality (regularities), and technology invents way of imple-menting of these discoveries in order to increase the efficiency of human work. Scientific work on some subject ends by a discovery, and technology starts with this discovery and is based on it. Invention is a new product that, through combining of conceptions/insights, makes functional unity. Consequently, technology is materialization of entire human knowledge. This is why we should know the difference between technology and science.



We have explained the term science, and from a great number of definitions of technology we have chosen five statements:

a) technology is specific social phenomenon that is a part of objective social reality,
b) it consists of all devices and means constructed for production and other activities,
c) it is the entirety of all developed systems that are changing through history, that are being uninterruptedly improved and developed,
d) basis of technology is meaningful using of natural laws, materials and phenomena,
e) technology is based on science.

Here we have to point out that the term technology lias a complex meaning. Basically there are two meanings: a) Technology is "systematic use of organized knowledge for practical activities, specially in production" or “science about regularities of materialistic-technical side of the whole of the production processes and using of these regularities on practical /eve/" and b) Technology has a broader meaning and is being used as a synonym for technique (in English also Technology).

Seeing a technology in an instrumentally anthropological way - Martin Heidigger points out that technology in its basic sense, is the meaningful and universal way of making tools, supplies, equipment, instruments as well as the universal manipulation with these tools and equipment. Philosophically, according to Aristotel there are four basic metaphysical principals of technology (*material, form, cause* and *purpose*). Heidegger goes further and points out the core, crucial meaning of technology, based in its Greek term and sense – technology is not just a skill, practical way of doing things, handicraft, activity – it is also a production - $\pi o \iota \varepsilon \sigma \iota \sigma$ (poesis =creation).

Science explains objective reality, and through technology we master it. For example, the discovery of electricity and its characteristics is the result of science (physics), and practical use of these data is the field of electrical engineering. All products of electrical engineering are the products of human mind - they were not discovered in objective reality. Because of the great number of different fields of application of scientific discoveries and the need of satisfying human needs - larger number of technological fields with great number of very specialized disciplines developed as well as disciplines that are on the edge of technology.

On the other hand – many authors, using the cases from the modern world of business and technology, tend to prove that technology isn't always an applied science, but some of the technological solutions may be the results of creativity not direct scientific research. Based on the case study of *Philips Sterling Engine* - *Marc J. de Vries* managed to identify three groups of technology: (a) ***experience based technologies***, (b) ***macro-technologies*** (c) ***micro-technologies*** – while challenging the need to change the paradigm according to which "the technology is an applied science" (De Vries, M.J.- 1996) [8]

It is clear that if the invention is not based on true cognition of objective reality it cannot function at all. We should also emphasize that the truth is the basic criterion for valuation of results of science, and that the efficiency is the final criterion for valuation of technology. In technological terms, the quantum jump is not the discovery of fundamental scientific principles on which researchers designed new technologies. Rather, it is the development of some practical hardware that has a decisive impact on the way that humans do or make things, and includes the important societal changes that result from the hardware development. [9]

Despite all these – we find that in modern technology creativity is derived from the deep insight into the nature of events. Namely – "*solutions for the key technological problems are based on scientific findings and it is almost impossible to find the obvious example of innovation that made a real turn in technology of our time that is not rooted in the scientific research.* (T.Perković, 1990.).

[8] Marc J. de Vries uses the case of the company "*Brabantia*" and its product – cork-screw.

[9] In computers, for example, the quantum jump is not the direct contributions *of Blaise Pascal, Gottfried Leibniz*, and *Charles Babbage* (as these took place in science and not technology), but the development of the ENIAC (Electronic Numerical Integrator and Calculator) in 1942. This machine was an incredibly high-speed, electronic, digital device that soon, with several improvements, led to instruments that could do much more in more effective ways. (*Ralph Sanders* in book….)

Technical- technological sciences[10]

Technical sciences can be treated as sciences of XX century - in XX century they have developed very dynamically and they have achieved extraordinary results - which had great impact on development of civilization, on entering of the world into post-industrial society and brought it within reach of artificial intelligence .[11]

Throughout history, technological developments have affected the lives of human beings. The connection between hardware and behavior affects the problems that society must address. Consequently, the characteristics of any technological enterprise influence the way in which humans live. The more we understand the nature of technology and technological change, the better prepared we are for meeting current as well as future challenges.

Knowledge gained during first seven decades of XX century has surpassed all knowledge accumulated during entire development of the civilization up to that moment - during last 20.000 years. In estimation of Stanford's University team that human knowledge was for the first time duplicated in 1900; next duplication happened 50 years later (year 1950), the next one just after ten years (1960), and the next only after seven years. It shows the exponential speed of duplicating of the overall human knowledge. Ray Kurzweil on the other hand points out the double exponential growth of human knowledge based on new technologies - through the use of intelligent machines.[12]

Technical and technological sciences deserve most of the credit. In the same time these sciences have great potential for the future of mankind (each and every human community, state). But, along with extraordinary results, development of technical sciences also brought number of thing dangerous for the development of human community; natural resources can be exploited, pollution of the nature, possible wrong development of these sciences in the sense of making life and working conditions worse, etc.

Today, technical sciences include very wide area. Whereas until few decades we could speak about several technical sciences (ex. civil engineering, mechanical engineering, electrical engineering and some

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[10] In classification of science area in Croatia exist term "Technical-technological science"

[11] We have to emphasize that technical sciences have had difficulties in obtaining its formal scientific status: for a long time scientists had discussions about question most of the time based on the difference between fundamental and applied scientific researches.

[12] *"Future technologies for sensory impairments will include automatic subtitles on the fly for the hearing-impaired, pocket-sized reading machines, automatic language translators, and intelligent devices sent through the bloodstream. These devices will also augment the senses for the general population."*

others), today there is scores of (so to speak classical) technical scientific disciplines and scores of new disciplines under new technical fields - such as: electronics, robotics, space technology, ecology, genetic engineering, biotechnology, cybernetics, informative technologies, nuclear technology, system engineering (they are all directly or indirectly included in technical sciences).

Development of technical sciences is conditioned by the number of factors within science in general as well as within the group of technical sciences, but also by deep structural changes in human society - especially in economy and military sector .[13]

Special influence on development of group of technical sciences has the process of globalization of modern world and appearance of the industry of knowledge. In these frames university concept of education in the field of technical sciences will have to be constantly modeled and adapted to the needs of technological stages. First of all it means that the educational process should be equipped with adequate technical tools and that the concept of teaching should be abandoned, and that the research concept of the university must be developed. For those changes great financial support and material investment are needed. Therefore the emphasis lies more and more on joining of education and implementation of the results of research. Electrical engineering is a branch of science and technology dealing with application of electricity in solving technical problems. For this purpose it studies the phenomena related with electricity and uses the results of these studies, together with knowledge of other technical sciences, for realization of technical employment of electricity.

In spite of the fact that ail fields of science and technology are important for development of civilization and every society, it can be said that electrical engineering, belonging to the group of modern technology and ail other sciences, can be counted in the group of science infrastructure disciplines. In other words, research (discovery) results as well as practical use (of an invention) through technical devices are crucial for modern scientific research work or social development in general. In communities where electrical engineering sciences are developed to the extent of enabling quick development of other fields of science and technology, phenomenon of development of other scientific disciplines is emphasized. In communities where this is not the case, the so-called positive discrimination of electrical engineering sciences is necessary for quicker scientific and research development (and by this technical & technological and general social development).

[13] After II World War many scientific researches, especially in the area of technical sciences, were stimulated and financed from the military budget.

Scientific research in modern civilization – specially in area of technology sciences – developed into industry of knowledge – who have self-mission and production, laws of development and set of opened questions; most important issues is:

1. Predicting future in technical - technological development,
2. Studying of complex reality and results of other disciplines in the same field or other field,
3. Co-ordinating of self-development in the field of technical sciences,
4. Social relations: *a*) science - society, *b*) relations within science,
5. Scientific research management,
6. Creating new terms and
7. Education in technology science.

4. Conclusion

The process of globalization of the modern world and phenomena of science industry have a special influence to development of science. Borders between fundamental and applied and between applied and development researches are thinner and thinner. Beside these, important changes are also present in the structure of researches; firstly - the number of scientists and researchers is constantly growing in developed countries, the same as the earmarked funds for these researches and education; secondly - instead of top scientists individuals, top teams of scientists and their associates of different profiles stand out through their results and discoveries. Narrowly specialized approach in researches and examination of specific problems is surpassed by inter-disciplinary and trans-disciplinary approach. Along with quantitative, intuitive methods are used more frequently. Time needed from scientific discovery to technical invention and further to mass employment in practice is being shortened.

Development of technical sciences is also conditioned by series of factor within modem science rich in different processes. Separation of certain scientific disciplines and new science takes place due to more efficient researches and newly observed problems. Due to the same efficiency scientific disciplines integrate into researches, and even new sciences bordering with different scientific fields (biophysics, biochemistry, etc.) are founded.

Scientific and research production cannot be built over night; results in the sphere of technical sciences (in most of the cases) are not coming from the work and imagination of individuals, but through education the development of creative teams. This aspect is crucial for the transitional countries; issues of creating professional teams, getting equipment, changing the attitude towards and social status of science and

its funding are not just issues of short or long term results – but the crucial points of survival in modern civilization.

In such framework the university concept of education and scientific research in the sphere of technical sciences, needs to position itself and be able to constantly adjust to the needs of ever changing technological eras. It means that the educational process is properly equipped with the adequate technical means, that lecturing system of the knowledge transfer is an outlived concept and that all the efforts are put to build a new research university.

For even initiating such a process there is a need to significantly change the management of scientific research and teaching system. At the same time there is must for significant financial and material investments and the ***entirely new practice*** of joint efforts and a blend of ***education***, ***research*** and the ***applied science***.

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